Bees in the medieval economy: Religious observance and the production, trade, and consumption of wax in England, c.1300-1555

The high and late Middle Ages saw a significant increase in demand for beeswax, a fundamental component of medieval Christian devotion, spurred by both changing socio-economic conditions and shifts in religious practice. The vast quantities of wax needed for churches and religious foundations in England drove a thriving international trade spanning from the hinterland of Novgorod to the port Lisbon, while at the same time encouraging widespread domestic beekeeping. This paper considers the impact of supply-side constraints, including the effect of environmental change on bee colonies, and increasing demand on wax prices, calculating the cost and quantity of wax purchased by large foundations, parish churches and individual offerings, to reveal the hitherto underexplored impact of religious consumption on the medieval economy.

This study seeks to understand the demand, production, trade and consumption of an often overlooked but highly significant commodity in medieval England: beeswax.[1] In this period, bees' value was not only economic, in being able to sell the honey and wax they produced, but also cultural, for bees were potent religious symbols in medieval Christianity. Medieval writers, observing no mating in bee colonies, believed bees were set apart from other animals in their chastity.[2] Consequently bees became closely connected with the two figures most strongly associated with virginity: Christ and Mary. In the fourth century Ambrose wrote that Christ, 'virgin-born, like a bee' was *apis aetherea*, the heavenly bee, while Mary too was virginal 'like a bee'.[3] This religious symbolism had a singularly important practical implication, for it meant that beeswax candles were necessary for the Mass.[4] So strong was the association of virginity with bees and consequently with wax candles that the Feast of the Purification of the Virgin Mary was known popularly as Candlemas, when the wax for the year was blessed and parishioners

[1] I would like to thank the British Academy/Leverhulme small grants scheme for funding this research; Lois Lane for collecting data from the enrolled customs accounts, Angela Huang and Alex Klein for their assistance; and the editor and anonymous referees for their critique and advice.

[2] Ambrose, *Hexameron*, trans. J.J. Savage (New York, 1961), p.213 (Book 5, chapter 21:67); on bees' spontaneous generation see e.g. Augustine, *De Civitate Dei*, ed. B. Dombart and A. Kalb (Tübingen, 1929), vol.2 p.119 (Book 15, chapter 27) and Isidore of Seville, *Etymologiarum sive originum libri XX*, ed. W.M. Lindsay (Oxford, 1911) Book 12, chapter 8:1-3. See also D. Hassig, Medieval Bestiaries (Cambridge, 1995), pp.52-54, 57

[3] O. Lippmann, *Geschichte des Zuckers* (Wiesbaden, 1970) p.41; J. P. Glock, *Die Symbolik der Bienen und ihrer Produkte* (Heidelberg, 1891) p.233.

[4] See also Lippmann, *Geschichte*, p.41; Glock, *Symbolik*, p.240. Tallow candles were allowed in churches and were also a source of lighting in wealthy houses (and as rush lights in poorer ones). Wax was also mixed with tallow and resin for torches.

brought a candle offering to the priest to burn in the church, often before an image of Mary.[5] Christ himself, the Light of the World, was compared to a candle, the wax his body, the wick his soul, and the flame the godhead.[6] The eleventh-century Exultet rolls from southern Italy, which contain the Easter proclamation to be sung before the lit Paschal candle, are notable for the particular attention paid to the collection of wax from hives to make the candle.[7] Easter involved the most spectacular display of light, but year-round candles lit the altars, burned on the roods and before each image, shrine, and many tombs in every church in Europe.

Over the Middle Ages religious practice became increasingly elaborate, and, especially from the early thirteenth century, Christocentric, involving greater celebration of feast days related to Christ and Mary.[8] Provisioning churches with lights was the cause of church ales, guild activities and pious bequests, and was a major expenditure for religious institutions of all sizes. The need for wax in Europe was constant and pervasive, yet the magnitude of the production, trade and consumption of wax has not yet been fully considered. The recent catastrophic decline in bee populations has caused concern for ecosystems worldwide and has highlighted bees' vulnerability to climatic shocks and environmental change. Through a study of the demand for, and supply of, beeswax in medieval England this paper sheds new light on the intersection of economy, environment and culture in the pre-modern world. Assessment of wax consumption demonstrates the tremendous cost of religious devotion in late medieval England and the impact of Christian practice on the European economy.

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[5] E. Duffy, *The Stripping of the Altars* (Yale, 1992), p.16.
[6] Ibid., p.18; also Lippmann, *Geschichte*, p.41.
[7] T. Kelly, *The Exultet in Southern Italy* (Oxford, 1996)
[8] A. Brown, *Church and Society in England 1000-1500* (Basingstoke, 2003), p.51; R. Swanson, *Church and Society in Late Medieval England* (Oxford, 1989), p.276, 289; Duffy, *Stripping*, p.3, 265; C. Harper-Bill, 'English religion after the Black Death', in W.M. Ormrod and P. Lindley (eds.) *The Black Death in England* (Stamford, 1996), p.109; the development of Corpus Christi is most indicative of this (on which see M. Rubin, *Corpus Christi* (Cambridge, 1991), esp. pp.199-204 and p.213-287).

First, the quantity of wax needed for basic Christian observance in parish churches, the largest total consumers of wax, is considered. Second, the cost and amount of wax consumed by large religious foundations is examined using the Sacrists' accounts of the cathedral priories of Canterbury, Durham, and Norwich, New College Oxford, Westminster Abbey and Winchester College. The data from these accounts is then used to consider factors which may have affected wax prices, including the impact of political disruption on wax imports and the role of weather and climate change on wax production and beekeeping. The emphasis on imported wax in the Sacrists' accounts accords well with what is known of Hanseatic trade to England, but parish churches too needed adequate supplies of wax.

English demand for Hanseatic wax has been much remarked upon, for the forests of the eastern and southern Baltic provided excellent conditions for thriving bee colonies, and it was a principal part of Baltic export trade, alongside fur, wood and metals.[9] However, as will be seen in the third part of the paper, assessment of the quantity of wax required for basic religious observance compared with wax imports suggests that the production of domestic wax must have been very great indeed. Despite its prominence in Hanseatic trade, at least until the late fifteenth century imported wax could only have been a small part of the total wax consumed in England, intended largely for wealthy foundations and households. The almost-absence of beekeeping in manorial accounts belies its importance within the household economies of smaller producers, and wax from the

[9] E.g. Dollinger, *Hanse*, p.30, 56; C. Jahnke, 'The Baltic trade', in D.J. Harreld ed., *A Companion to the Hanseatic League* (Leiden, 2015); K.-O. Ahnsehl, *Thorns Seehandel und Kaufmannschaft* (Marburg, 1961), p.21; see also C. Warnke, 'Der Handel mit Wachs zwischen Ost- und Westeuropa im frühen und hohen Mittelalter', in *Untersuchungen zu Handel und Verkehr der vor- und frühgeschichtlichen Zeit* 4 (1987) pp.12-14, and throughout for the early trade in wax, and p.553 for favourable habitats. Hanseatic merchants brought back large quantities of English cloth.

hundreds of thousands of skeps they kept would have found a ready market in the thousands of parish churches across England.

Not all beeswax was used for religious purposes, and although tallow was more common, wax was also used for lighting in wealthy households. The royal household used 30 pounds of wax a week on average from late summer to early autumn 1289, and the queen's household averaged 26 pounds a day in the autumn of 1291.[10] Even the ends of candles were valuable, making up part of the payment to household officials.[11] Wax was also used for seals, and dyed sealing wax was an expensive commodity which large households consumed in some quantity.[12] But by far the greatest use of beeswax, affecting almost the entire population of medieval Europe, was for candles to light churches.[13]

I.

Imagery of light and dark permeated Christian devotion, and meant that wax candles were needed by people at all levels of medieval society. In order to assess the economic impact of this aspect of religious practice, it is first necessary to consider the total amount of wax consumed and how this changed over time.

[10] TNA E 101/379/20; E 101/381/17.

[11] In Henry I's household, the chancellor was given '1 large wax candle and 40 pieces of candle'; other officers were paid in wax according to their status: R. FitzNigel, *Dialogus de Scaccario*, ed. and trans. E. Amt (Oxford, 2007), p.198.

[12] In 1302/3 4 pounds of red sealing wax were purchased at 2s./lb for the expenses of Edward I's sons: TNA E 101/363/14 31. For comparison, the following year Norwich Cathedral Priory paid 7.65d./lb for plain white candle wax. In 1313/4 Thomas of Lancaster's household spent £314 7s 4.5d on sealing wax: Dummelow, *Wax Chandlers*, p.10.

[13] The span of southern European wax trade is indicated by Pegolotti, who recorded 40 fourteenth-century markets: B. Pegolotti, *La pratica della mercatura*, ed. A. Evans (New York, 1936); nor was England the sole market for Hanseatic wax: see Ibid. p.241 for 'cera di Pollana' in Bruges, and the business of the Veckinhusen family in P. Dollinger, *The German Hansa* trans. D.S. Ault and S.H. Steinberg (London, 1970) pp.235; Moorish wax arrived at London on a Venetian galley in 1481: H.S. Cobb, *Overseas Trade of London Exchequer Accounts, 1480-1* (London, 1990) p.50.

England was exceptional for its considerable density of parish churches, 9,000 of which existed by the early thirteenth century.[14] Population growth, Church reform, and an emphasis on greater education of the laity, meant that over the thirteenth century parish churches proliferated and became the focal point of religious devotion.[15] This was a period of declining standards of living, and much of the population would have consumed only a minimal amount of expensive wax. After the Black Death, however, standards of living rose, allowing a greater part of the population to spend money on non-subsistence items, including religious practice.[16] It seems likely that increased per capita consumption after the Black Death at least compensated for the decline in population, and that the socio-economic conditions of the later Middle Ages combined with trends in religious practice to drive a growing demand for wax in parish churches.

The accounts of church wardens, responsible for managing the income and expenditure of parish churches, offer the clearest insight into the provisioning of light at this level. These accounts are problematic. First, although they sometimes include accounts of wax-silver, they do not record the wax purchased for services, which was dealt with by the incumbent; they also often do not include wax raised from funds by guilds and other associations, or purchased by individuals for life-cycle events.[17] This excludes much, if not most, of the wax consumed annually. Second, the majority of church wardens' accounts post-date the medieval period, and the most informative earlier accounts are from the late fifteenth and early sixteenth centuries, when wax consumption, for the

[14] Brown, *Church and Society*, p.86; E. Duffy, 'Religious belief', in R. Horrox and W.M. Ormrod, *A Social History of England 1200-1500* (Cambridge, 2006), p.304.
[15] Brown, *Church and Society*, pp.37-60; R. Bartlett, *England Under the Norman and Angevin Kings, 1075-1225* (Oxford, 2000), pp.378-387.
[16] Swanson, *Church and Society*, p.255, 280-284. C. Platt, *Parish Churches of Medieval England* (London, 1981), pp.88-146, esp. pp.98-107; C. Dyer, *Age of Transition?* (Oxford, 2005) p.76; J. Sear, 'Consumption and trade in East Anglian Market Towns and Their Hinterlands in the Late Middle Ages' (Unpublished PhD thesis, University of Cambridge, 2015) pp.245-272, 328.
[17] For lay provisioning of lights see D. Postles, 'Lamps, lights and lay folk: 'popular' devotion before the Black Death', *Journal of Medieval History* 25 (1999) 97-114.

reasons noted above, was probably at its greatest. This makes any calculation of wax consumption in parish churches uncertain. Nonetheless, it can be seen from these accounts that, apart from repairing the fabric and bells of the church, wax was usually the largest single expense recorded in the church wardens' accounts. At Walberswick (Suffolk) in 1497, £1 2s. 7d. was spent on wax, 4s. 3d. more than was spent on making six pairs of surplices and a new cloth for the crucifix; wax and attendant labour accounted for 63% of the necessary expenses in the warden's account for Bishop's Stortford (Herts.) in 1432; at Mildenhall (Suffolk) the cost of the Paschal alone was one eighth of the annual salary of the parish clerk. [18]

At the very least, each church was to have two wax candles to be lit on either side of the priest throughout the central portion of the Mass, although it is clear from church wardens' accounts that the rood light was also of great importance.[19] A plethora of lights are recorded in the wardens' accounts, and expenditure on these candles was significant: 96 lbs of wax were purchased for the rood lights between 1474-6 at the church of St Margaret Westminster; at Saint Edmund Salisbury they weighed 42 lbs in 1490/1.[20] More was undoubtedly spent on the candles for the numerous holy images which filled parish churches.[21] An indication of where these lights were placed is given in the account for Arlington (Sussex) 1469, in which it is noted that 3d. were spent on making the candle which burnt in front of an image of St Michael, while 2d. were spent on lights for altars to Saints Katherine and Margaret and St Pancras, in addition to 19d. for making other

[18]R.W.M. Lewis, *Walberswick Churchwardens' Accounts, A.D. 1450-1499* (London, 1947), p.80; S. Doree, ed., *Early Churchwardens' Accounts of Bishops Stortford, 1431-1558* (Ware, 1994) p.12; *Records of the Churchwardens of Mildenhall: Collections (1446-1454) and Accounts (1503-1553)* (Woodbridge, 2011) p.47.
[19] Rubin, *Corpus Christi*, p.60; see also N.J.G. Pounds, *History of the English Parish* (Cambridge, 2000) p.430.
[20] J.C. Cox, *Churchwardens' Accounts from the Fourteenth Century to the Close of the Seventeenth Century* (London, 1913), p.166; H.J.F. Swayne, *Churchwardens' Accounts of St. Edmund and St. Thomas, Sarum, 1443-1702* (S.l., 1896), p.38. Additionally 6 pounds of wax were purchased for the trendell in 1491 and 14 pounds of new wax were purchased for the candle in front of the cross in 1483/4: Swayne, *St. Edmund and St. Thomas*, p.38, 36.
[21] The Lady candle at Great St Mary's Cambridge weighed 20 pounds in the early sixteenth century: J.E. Foster, *Churchwardens' Accounts of St. Mary the Great, Cambridge, from 1504 to 1635* (Cambridge, 1905), p.38.

lights.[22] Special wardens were often employed to look after the candles, as at Spelsbury (Oxon.) where wardens were appointed for the lights of Saints Andrew, Anthony, Clement, Christopher, Erasmus, George, Katherine, our Lady, our Lady in the chapel, Mary of Pyte, Michael, Nicholas, and the Trinity.[23] The candles before images and in ancillary chapels were usually the purview of guilds and other associations, and the amount of wax is therefore not always recorded in the main wardens' accounts. Occasional mention of the amount of money raised, however, suggests these could supply substantial candles: 10s. and two strikes of barley were given for the St George light alone at Spelsbury in 1524.[24]

Light was central to conveying the Easter message. Wax for the sepulchre was among the most common bequests in medieval wills, and evidently very large amounts of wax could be raised for this purpose: at St Mary's Cambridge 248 lbs of wax were handed over by the wardens of the sepulchre light to their successors in 1523, and even as late as 1541 the church at Marston in Oxfordshire spent 12s 4d, the equivalent of 37 days' work for an agricultural labourer, on the sepulchre light.[25] The Paschal candle, lit for the Easter vigil, burnt throughout Easter and used for forty days until the Ascension, was a major expenditure often weighing between 30 and 40 lbs.[26]

In addition to Easter and the Purification, church wardens' accounts show wax candles to have been purchased for other important days, including Christmas with its own light-

[22] BL, Add. MS 33192 f16r, f11r, f9v.
[23] F.W. Weaver and G.N. Clark, *Churchwardens' Accounts of Marston, Spelsbury, Pyrton* (Oxford, 1925), p.31.
[24] Weaver and Clark, *Marston, Spelsbury, Pyrton*, p.39.
[25] Duffy, *Stripping*, p.34; Foster, *St. Mary*, p.49; Weaver and Clark, *Marston, Spelsbury, Pyrton*, p.12; wage rates from R. Allen, 'Prices and wages in London & southern England, 1259-1914', *Consumer Price Indices*, International Institute of Social History: http://www.iisg.nl/hpw/data.php#europe.
[26] E.g. Swayne, *St. Edmund and St. Thomas*, p.9; although it could be smaller: at Mildenhall the Paschal weighed 3 pounds (Middleton-Stewart, *Mildenhall*, p.91n).

filled liturgy.[27] Just as candles marked every stage of the liturgical year, so too did they mark every stage of life: candles were placed in infants' hands when they were baptised, held by women when they were churched and when they married, carried before the Host when it was taken to visit the sick, placed around the body after death, taken with the body as it was carried to the grave.[28]

The altarage accounts of the collegiate church of Howden (Yorks.), which record the endowments for Masses for the dead among other receipts for income from the laity for services performed for them, provide insight into the amount of money given for wax for funerals.[29] This is shown in Table 1.

Table 1: Number of deaths and amount of money left for wax at Howden, 1498-1513

	Men (avg. bequest)	**Women (avg. bequest)**	**Children (avg. bequest)**	**Total deaths**	**Total bequests**
1498/9	15 (5.7d.)	6 (4d.)	9 (2.8d.)	30	11s. 4d.
1511/2	8 (6.9d.)	6 (4.8d.)	22 (2d.)	36	10s. 6d.
1512/3	18 (6.9d.)	12 (6.3d.)	25 (2d.)	55	20s. 11d.
Total	41 (6.4d.)	24 (5.4d.)	56 (2.1d.)	121	42s. 9d.

Source: DCM 4.1 Ebor 56-60

Although wealth no doubt determined the amount of wax used, status was also important. On average more money for wax was left for adult men than women, while the least was given on behalf of infants. If wax bought with money from bequests was purchased at the same price as the wax the church used for other candles, oblations from parishioners at Howden would have amounted to 17 pounds in 1498/9, 15.75 pounds in 1511/2 and 40 pounds in 1512/3. That the amount of money given to the church for wax did not decline even as the price of wax fell is further indication of how important wax candles were to lay piety. The accounts show that it was typical at Howden in the

[27] At Walberswick (Suffolk) candles were made for Christmas, Trinity Sunday, the Nativity of St John the Baptist: R.W.M. Lewis, *Walberswick Churchwardens' Accounts, A.D. 1450-1499* (London, 1947), p.13, 61, 75.
[28] C.M. Woolgar, *The Senses in Late Medieval England* (New Haven, 2006), p.152; K.L. French, *Good Women of the Parish* (Philadelphia, 2008), p.61.
[29] Durham Cathedral Muniments (DCM) 4.1 Ebor.59 f1r.

late fifteenth and early sixteenth centuries to give money for at least half a pound of wax per adult death. More money was left for wax at Kirkby Malham (Yorks.) in the mid-fifteenth century, where a payment of 7d. called 'nythewax' was paid upon the death of adult parishioners.[30]

The high levels of mortality which prevailed in the century and a half after the Black Death further encouraged extensive provisioning of wax for funerals and anniversaries. Gifts of wax are ubiquitous in late medieval wills, often as a means of marking social status. Few people would have been in the position of Margaret Brafeld, who in 1487 left £100 for twenty years of requiem Masses and thirteen wax torches weighing thirteen pounds each to be burned on the anniversary of her death, the unburnt remains of which were to be sent to thirteen religious institutions, but many wills show provisions for candles for several lights in the same church.[31] Large quantities of wax could have been purchased from the profits of the sheep left for the provision of lights at St Albans in 1479.[32] Some people clearly intended their bequests to last for several years, as in the case of the vicar of St Stephens who bequeathed a cow, the profits from which he intended a five-pound wax candle for the Easter Sepulchre to be maintained.[33] Parishioners even left hives of bees specifically for lights, presumably intending the wax from the hives to be used to make candles.[34] By their nature wills were written by those wealthy enough to have goods or money to disperse. Consequently even at this late stage the poorest parishioners are largely invisible, although the small amounts of money enrolled in the accounts at Howden indicate the importance of wax to all strata of society.

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30 P. Heath, ed., *Medieval Clerical Accounts* (York, 1964), p.22.
31 D. Edwards, *Early Northampton Wills* (Northampton, 2005), p.142. For example, in 1479 Thomas Palmer gave one pound wax each for the rood light, Holy Trinity, St Mary's chapel, and St John Baptist: S. Flood (ed.) *St Albans Wills 1471-1500* (Hitchin, 1993), p.50.
32 Ibid. p.47
33 Ibid. p.129.
34 Four hives of bees were left to maintain the light of the Blessed Mary in the parish church of Mildenhall in 1455, and two hives with bees were left for the lights of the church at Mildenhall in 1472: Suffolk Record Office SRO(B) Baldwyne 179, 538. Thanks to Jo Sear for these references.

With this in mind, one way of attempting an estimate of wax consumption in parish churches is by calculating the minimum amount of wax needed in a church. In the absence of direct evidence for total wax consumption, an estimate of the lower bound can be made using a later account and working backward. Cromwell's injunction of 1538 forbade wax except for that used on the altar, the rood and the sepulchre.[35] Four years later, St Mary's Dover, a wealthy hospital at the time of the *Valor Ecclesiasticus* of 1535, spent 13s 6d on wax for lights in the church, which, including manufacture, would have purchased about 15 pounds of wax.[36]

Using St Mary's as a benchmark in conjunction with the valuations recorded in the *Taxatio Ecclesiastica* of 1291/2, and bearing the abovementioned caveats in mind, a basic assessment of minimum wax consumption in parish churches can be made. If the very poorest churches, the 17 per cent valued at less than £5 in the *Taxatio*, burned half as much wax as St Mary's; the middle 51 per cent of churches valued at £5-15 burned as much as St Mary's did in 1538; the remaining third of churches burned twice as much, but the top 0.6 per cent valued at £100 or more burned three times as much, 159,000 pounds of wax would have been consumed by the most rudimentary Christian observance in parish churches.

Of course, the foregoing discussion is based only on annual purchases of new wax. This new wax was often added to 'old' wax reused from candle ends held over from the churches' own stock, or purchased from wax chandlers who were paid by the pound to make candles.[37] This recycling allowed churches to ensure continuous supplies of enough

[35] 'The second royal injunctions of Henry VIII' in W.J. Hardy and H. Gee (eds.) *Documents Illustrative of English Church History* (London, 1896), p.277-278.
[36] British Library Egerton MS 1912 26v, assuming 6d./lb as recorded for Paschal that year.
[37] E.g. in 1543/4 at St. Edmund Salisbury 30 pounds was added to 70 pounds of old wax for the rood light: Cox, *Churchwardens' Accounts*, p.54; Winchester college paid the chandler 1d./lb for most of the fifteenth century: Winchester College Muniments (WCM) 22110-22175.

wax to make large candles, creating the impressive displays of light deemed necessary for Christian ritual. Even with the existence of old wax, churches still bought much new wax each year. This calculation, therefore, underestimates wax consumption for the larger churches, and does not include wax used for any other purpose, such as oblations, images, ancillary altars, shrines, chantries, local chapels, and life-cycle events which were so vital a part of pre-Reformation religious practice.[38] Wax was an important votive offering, in the form of candles, which were often made to measure for an ailing person, or shaped into injured or diseased body parts.[39] There were too many of these wax votives to count at the shrine of St Thomas Cantilupe at Hereford Cathedral in 1307.[40] This minimum amount of wax needed for the basic functioning of parish churches would therefore not have met the needs of most parishioners. This points toward the conclusion that even the most minimal consumption would have required immense quantities of wax, met through annual purchases, smaller occasional purchases and the recycling of old wax.

Before the Reformation, then, English churches were ablaze with light. Even a modest church would have had lights on the altar, rood, the trendall suspended before the rood, the cross, the font, at least one image, the Paschal, the Sepulchre, new candles for feast days, additional lights for parishioners and for the Host. It is difficult to see how the baseline calculation could meet all ten of these needs, and in fact it seems more probable that even the most abject of churches would have required several extra pounds of wax

[38] This discussion also excludes torches, because the proportion of resin to wax is too often unclear. But expenditure on torches could be large: 40 pounds of resin were purchased for torches at St Edmund Salisbury in 1514/5 (Cox, *Churchwardens' Accounts*, p.165). The shrine was 'often the best lit place in the cathedral': B. Nilson, *Cathedral Shrines of Medieval England* (Woodbridge, 1998), p.51; this was also a period of pilgrimage to local shrines: Duffy, 'Religious belief', p.316-318; Swanson, *Church and Society*, p.247; Harper-Bill, 'Religion', pp.112-113.

[39] In 1245 Henry III spent £51 13s. 6d. on 15 candles 'of his size' to be put around the shrine of Edward the Confessor: Nilson, *Cathedral Shrines*, p.103. On votives: Ibid., p.101; U.M. Radford, 'The wax images found in Exeter Cathedral', *The Antiquaries Journal* 29 (1949), 164-168.

[40] Nilson, *Cathedral Shrines*, p.101

for each purpose per year, even if they were recycling old wax, essentially doubling the initial baseline calculation.

Just as parishioners lavished their local churches with light, so too did wealthy households buy wax for their private religious observance. In February 1464 Isabella, Lady Morley, paid 20d to a wax chandler for making 24 pounds of wax into candles *pro oblacionibus et missis celebrandis*, and a further 16 pounds *ad usum domini*. The household accounts of Bishop Mitford show £6 14s 2d spent on 311 pounds of wax in 1406/7. Although not all of this was for religious observance, much of it apparently was, as 31 lbs of wick were bought for Candlemas and Easter, and the entries for household lights in the daily accounts are for tallow, rather than wax, candles.[41] Royal households, always huge consumers of wax, were particularly extravagant in their use of wax for religious purposes—in 1247 Henry III gave 1,000 lbs of wax to Westminster Abbey for a single candle at the Purification, while 1,000 lbs of wax were purchased for Alexander III of Scotland and his wife when they celebrated the Assumption at Woodstock in 1256.[42] Royal funerals and obits were equally generously provisioned with wax—over 1,000 pounds of wax surrounded the tomb of Anne of Bohemia in 1397/8, and 560 pounds were purchased for the herse of Anne Neville at Westminster in 1485.[43]

The placement of royal tombs in monasteries and cathedrals is a reminder that large quantities of wax were consumed in great religious foundations, which, unlike parish churches, provide well-documented evidence of wax purchases. Analysis of the Sacrists' accounts of the cathedral priories of Canterbury, Durham, and Norwich, Westminster Abbey, Winchester College, and New College Oxford sheds light on the trade in wax

41 C.M. Woolgar, *Household Accounts from Medieval England* (Oxford, 1992), pp.407-8.
42 P. Nightingale, *A Medieval Mercantile Community: The Grocers' Company and the Politics and Trade of London, 1000-1485* (New Haven, 1995) p.71, 73.
43 Westminster Abbey Muniments (WAM) 23975; WAM 19730; see also funeral expenses for Thomas of Lancaster in Woolgar, *Household Accounts*, vol. 2, pp.680-2.

across England.[44] These religious foundations have been chosen for their geographical spread and the length of the series. The Sacristan was the obedentiary charged with managing the chapel, including the furnishings, fabric, and purchasing items necessary for masses. Wax was the most expensive item, on average accounting for about half of the total amount of money recorded in the main chapel expenses (the *custus capelle*).[45]

On average Canterbury spent £35 9s. on wax, Durham £12 8s., New College £4 7s., Norwich £20 12s., Westminster £32 15s., and Winchester£5 4s.. The nature of the accounts means that it is not always possible to determine how much wax was purchased in a given year. Table 2 shows the average amounts of wax purchased, excluding years when the accounts are obviously incomplete.

Table 2: Average amounts of wax purchased in pounds, 1273-1556

	Canterbury	Durham	New Coll. Oxford	Norwich	Westminster	Winchester
Mean	1378	451	195	812	1384	201
Mode	1512	493	168	280[a]	1568	224
n	48	59	37	56	108	117

[a] The difference between mean and mode is caused by the high variability in the amount of wax purchased at Norwich Cathedral Priory.
Source: CCA DCc-Sacrist/6-75; DCM Sacrist 1352/3a-1535/6; New College Oxford Box 24 7330-7357, Box 25 7375-7402, Box 26 7403-7413, Box 44 7713-7722, Box 27 7441-7476; DCN 1/4/1-126; WAM 19621-19807; WCM 22078-22212.

This represents only a small selection of the cathedrals in medieval England and the numerous monasteries and colleges of varying degrees of wealth spread across the country. Again, the Sacrists' accounts omit the many other parts of the church in which wax was consumed, in particular shrines and ancillary altars. These were also important consumers of wax. For example, eight candles lit the shrine to St Thomas at Canterbury

[44] Canterbury Cathedral Archives (CCA) DCc-Sacrist/6-75; DCM Sacrist 1352/3a-1535/6; New College Box 24 7330-7357, Box 25 7375-7402, Box 26 7403-7413, Box 44 7713-7722, Box 27 7441-7476; Norwich Dean and Chapter (DCN) 1/4/1-126; WAM 19621-19807; WCM 22078-22212.
[45] B. Harvey, *The Obedentiaries of Westminster Abbey* (Woodbridge, 2002) p.69. At Norwich in 1289/0 £28 11s. 11d. was spent on wax, wine was second biggest expense at £6 9s. 6d.: DCN 1/4/9.

in addition to four on the altar, while at Ely Cathedral 127 pounds of wax were sold by the keeper of the shrine of St Etheldreda in 1424/5 alone.[46]

The evidence suggests a very great demand for wax from all levels of medieval society. This was supplied internationally, via long-distance trade, and domestically, through small-scale beekeeping.

II.

The Sacrists' accounts provide a starting point from which to consider the supply and cost of wax in medieval England. These accounts separate the raw wax from the cost of making the candles. In most years transportation appears as a separate entry, and even when transport cannot be separated from the total cost of wax, the impact on the price per pound was very small. At Westminster in 1395/6 1092 lbs of wax were purchased for £26 4s., the carrying of which cost 12d., which if included increases the price by 0.01d/lb. Even at Durham, where, in 1487-8, wax was purchased in Newcastle and York, the cost of transport averaged about 0.1d/lb, more than at Westminster, but not enough to alter the cost comparisons significantly.[47] The cost per pound of wax is often given in the account, in addition to the amount of wax purchased and the total cost of the wax. In the majority of years the price given per pound and the price per pound calculated from the total are very similar or equal. However, in some years the difference is more significant, and preference has been given here to the price calculated from the total cost of wax.[48]

The source data and the mean price per pound of wax given in the accounts and calculated from the total is summarized in Table 3 below.

[46] R.N. Swanson, *Catholic England: Faith, Religion, and Observance Before the Reformation* (Manchester, 1993) p.187; see also Nilson, *Cathedral Shrines*, pp.50-1.
[47] WAM 19655, DCM Sacrist 1487/8.
[48] See Appendices A-B for price series.

Table 3: Mean wax prices in pence per pound and number of observations from religious institutions, 1273-1556

Price per pound given in accounts							
	Canterbury (n)	Durham (n)	New Coll. (n)	Norwich (n)	Westminster (n)	Winchester (n)	Weighted average (n)
1273-1350	N/A	6.69 (1)	N/A	4.89 (1)	5.75 (1)	N/A	5.78 (3)
1350-1399	6.27 (3)	6.25 (3)	5.54 (5)	N/A	5.82 (21)	6.48 (2)	5.89 (34)
1400-1449	5.14 (8)	5.49 (18)	5.43 (17)	6.18 (3)	5.04 (18)	5.47 (22)	5.37 (86)
1450-1499	5.69 (18)	7.58 (8)	6.55 (10)	N/A	5.75 (37)	6.38 (31)	6.15 (104)
1500-1556	4.91 (4)	8.00 (1)	4.64 (1)	6.19 (9)	5.97 (28)	6.06 (26)	5.98 (69)
Average (d.)	5.51	6.22	5.76	6.09	5.70	6.03	5.85
Number of annual averages	33	30	33	12	104	81	293
Price per pound calculated from total cost							
1273-1349	N/A	6.67 (1)	N/A	6.01 (26)	5.75 (1)	6.01 (1)	6.02 (29)
1350-1399	6.27 (3)	6.82 (20)	5.34 (7)	6.23 (1)	5.70 (22)	5.90 (4)	6.10 (57)
1400-1449	5.07 (18)	5.48 (20)	5.44 (18)	5.30 (5)	5.18 (20)	5.52 (32)	5.36 (113)
1450-1499	5.58 (17)	6.60 (2)	6.41 (12)	6.34 (11)	5.91 (36)	6.30 (33)	6.09 (111)
1500-1556	4.76 (9)	8.00 (1)	8.70 (1)	5.89 (10)	5.89 (25)	6.08 (38)	5.90 (84)
Average (d.)	5.26	6.22	5.81	5.99	5.72	5.97	5.82
Number of annual averages	47	43	38	27	103	107	365

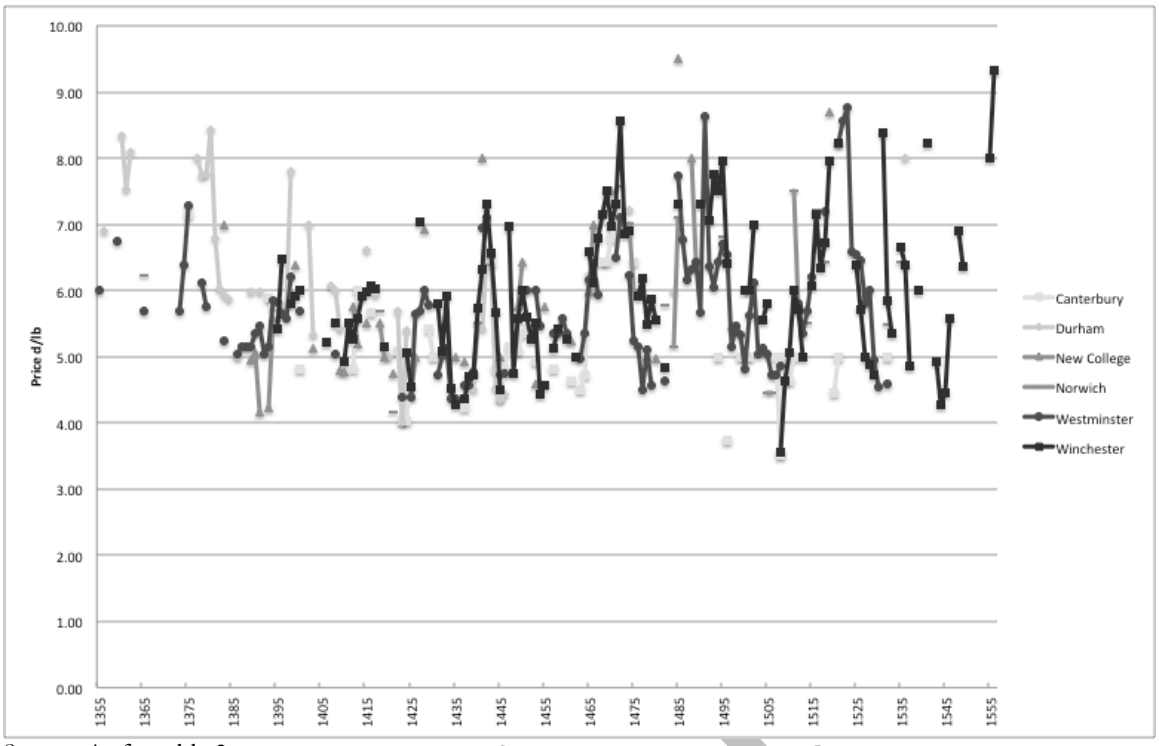
Source: As for table 2.

[a] Note: Years represented by given and calculated prices do not necessarily overlap. The annual averages represent 454 individual observations of prices given per pound and 608 observations of prices calculated from total. See Appendices A-B for data sets.

Table 3 shows that less than a penny separates the average prices, although Canterbury bought wax at the lowest price while Durham paid the most. The comparatively very low average price for Canterbury in 1500-1556 can be explained, at least in part, by the lack of overlap between the years represented in this series and the other series.

Within these sets, the late fourteenth and fifteenth centuries are the best represented. For purposes of clarity the less well-covered earlier period has been excluded from Figure 1 below.

Figure 1: Price per pound of wax in pence 1355-1556



Source: As for table 2.

No strong relationship between prices and the amount of wax purchased can be demonstrated for any of the series, but there are a number of possible reasons for the variation in prices between foundations, perhaps most important being the market at which the wax was purchased and the quality of the wax.[49]

Much of the wax purchased by these large religious foundations was imported from the great wax-producing regions of Europe, particularly the vast Baltic hinterland stretching between Novgorod, Smolensk, Lvov and Warsaw where pine forests interspersed with spruce and oak allowed for plenty of ground vegetation and provided an ideal habitat for bees.[50] The origin of wax is noted for 210 purchases in the accounts for New College, Winchester, and especially Westminster. Wax 'de Polane', indicating wax notionally from

[49] Pearson correlation between prices calculated from total and the amount of wax purchased: Canterbury r=0.16; Durham r=0.34; New College r=-0.16; Norwich r=-0.26; Westminster r=0.04; Winchester r=-0.04.
[50] Jahnke, 'Baltic', p.218; on this and the difference between skep and sylvan production see Warnke, 'Der Handel mit Wachs', pp.553-4.

Poland was the most common: at New College, Poland was the only place of origin given, while at Westminster 64% of the entries which record the place of origin name Poland, and at Winchester wax from Poland accounted for 95% of entries with a place of origin. For twelve years in the 1360s and 1370s and again in the 1430s, wax from Lübeck is also noted in the Westminster accounts. This wax most likely also came from the eastern Hanse region, although perhaps not always specifically Poland.[51] The difference may have been that the wax specifically from Poland was shipped from Prussian Danzig rather than Lübeck. Much less frequently mentioned is Lisbon, from which four purchases of wax are noted at Winchester in the 1440s and 1450s, and twelve purchases by Westminster, once in 1364/5 and the rest over the middle and late fifteenth century.[52] Winchester's closest port was Southampton, whose position on the trade route from Iberia meant that southern wax was of greater importance there than at the eastern ports and London, where Hanseatic wax prevailed.[53] Indeed, the purchases of Lisbon wax at Westminster tended to be in years when wax imports into London were unusually low, suggesting an underlying disturbance in Hanseatic trade.[54] Wax from Poland was almost always more expensive than that from Lübeck and Lisbon.[55] Wax 'de Polane' must have been a designation of both origin and quality, for wax from the forests of Eastern Europe was exceptionally good, thanks in large part to the Hanseatic merchants' well-

[51] Dollinger, *Hansa*, p.125. New College: 44/95 have place of origin, all from Poland; Westminster: 72/186 have place of origin, 47 Poland, 13 Lübeck, 12 Lisbon; Winchester: 93/190 have place of origin, 89 Poland, 4 Lisbon.

[52] WCM 22116, 22125, 22126; WAM 19630, 19668, 19675, 19676, 19678-9, 19680, 19717-8.

[53] Compare S. Jenks, *England, die Hanse und Preußen: Handel und Diplomatie 1377-1474* vol. 3 (Cologne, 1992), pp. 985-997 (London) with 1064-1071 (Southampton); H.S. Cobb, *The Local Port Book of Southampton for 1439-40* (Southampton, 1961).

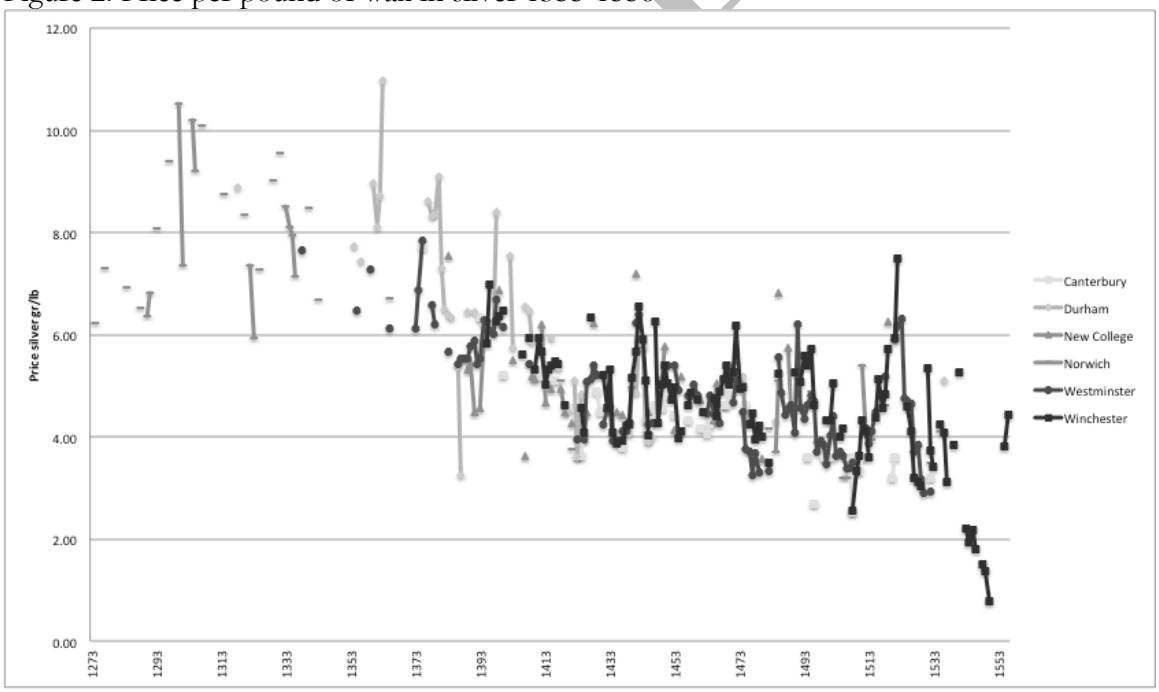
[54] As in 1434/5, 1437/8 and 1438/9, although wax from Poland and Lübeck was also purchased in these years; 1426/7; 1470/1 and 1471/2 when wax from Poland also bought. Lisbon wax was purchased in three undisrupted years: 1364/5, 1433/4, 1436/7 (WAM 19676, 19679, 19689, 19668, 19717, 19718, 19675, 19678, 19630, 19675, 19678).

[55] Westminster 1471/2: WAM 19748; comparing only years in which purchases of wax from different places are noted.

documented insistence on quality control.[56]

Expressing prices in silver to take debasement into account (Figure 2, below) sharpens the extent of the decline, although with more stability in the sixteenth century than shown in the nominal prices. Falling prices the end of the period can be attributed in part to Tudor-era debasement. In this, wax prices appear to have followed a similar trajectory to other goods during this period.[57] To put this cost in perspective, if expressed as agricultural labourers' wages, the price of a pound of wax fell from just over 5 days' work in 1300, to 2.5 days in 1354, before falling to 1.5 days in 1400 and remaining at this average for the rest of the period, falling below 1 day's work only once, in 1544.[58]

Figure 2: Price per pound of wax in silver 1355-1556



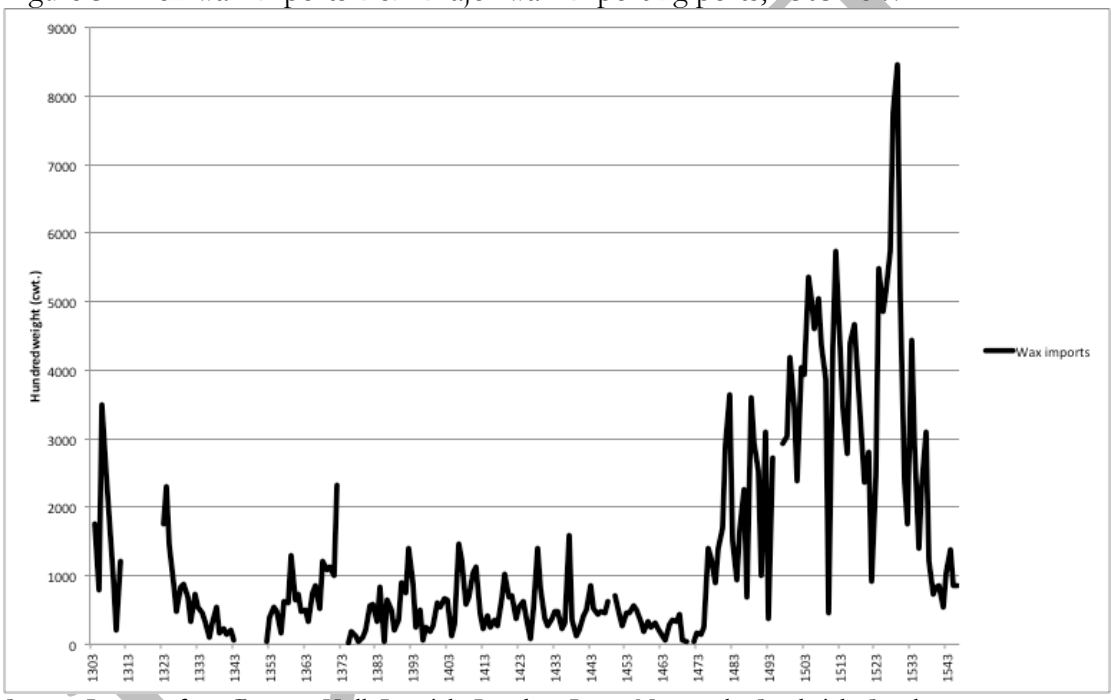
Source: As for table 2. Silver weights: R.C. Allen 'Prices and wages in London & southern England, 1259-1914', *Consumer Price Indices*, International Institute of Social History: http://www.iisg.nl/hpw/data.php#europe.

The extent to which wax with no origin given in the Sacrists' accounts was domestic or

[56] Jahnke, 'Baltic', p.218; Dollinger, *Hansa*, pp.235-6; e.g. W. Schlüter, *Die Nowgoroder Schra in sieben Fassungen vom XIII. bis XVII Jahrhundert* (Dorpat, 1911), pp.152-3.
[57] See appendix C.
[58] Wage rates from Allen, 'Prices and wages'.

perhaps mixed, cannot be determined, but it is clear that imported wax was an important commodity for these extraordinarily wealthy institutions. Price movements, in terms of nominal prices and silver content, correspond with major changes in the trading conditions of the Hanseatic region, whose merchants dominated the wax trade to England. The significant impact of this on wax imports into England is clearly demonstrated in Figure 3, which shows alien wax imports into England recorded in the enrolled customs accounts.

Figure 3: Alien wax imports from major wax-importing ports, 1303-1547



Source: Imports from Boston, Hull, Ipswich, London, Lynn, Newcastle, Sandwich, Southampton, Yarmouth in S. Jenks, ed., *The Enrolled Customs Accounts: TNA:PRO E 356, E 372, E 364*, 12 vols. (Kew, Surrey, 2004-2013); G. Schanz, *Englische Handelspolitik gegen Ende des Mittelalters*, vol. 2 (Leipzig, 1881). See Appendix D for missing accounts.

From 1303 alien wax imports were liable for a custom of 12d. per hundredweight. Although Figure 3 does not capture denizen imports, the success with which Hanse cities excluded English merchants from the Baltic trade suggests foreign merchants were responsible for the majority of wax imported into England.[59] The custom on wax, which

[59] The Hanseatic staple at Bruges, or periodically Antwerp (as between 1438-38) offered English merchants an opportunity to import Baltic wax: Lloyd, *Hanse*, p.79, 40.

meant these imports were noted separately in customs accounts, when used in conjunction with the price series from the Sacrists' accounts, offers an opportunity to consider how political disruption may have affected long-distance trade into England.

The late fourteenth century saw a period of war favourably concluded for the Hanse, the result of which was the Treaty of Stralsund in 1370, after which the Hanse consolidated its control over trade in the Baltic and North Seas.[60] The trading environment in this period no doubt contributed to the fall in prices. The decline in imports in the middle of the fifteenth century similarly corresponds with a period of internal discord, compounded by the changing relationship between the Prussian Hanseatic cities and the Teutonic Order. The rise of the union of Poland-Lithuania following the defeat of the Teutonic Order led to continued disruption during the middle of the fifteenth century, with Danzig particularly affected in the 1450s and 60s, while trade with Livonia was also disturbed.[61] With the principal production and trading centres under pressure, wax imports fell and prices rose, becoming increasingly unstable.

Conflict between the Hanse and England in the late 1440s over trading privileges and the exclusion of English merchants from Baltic trade contributed to price volatility.[62] It can be seen that the Anglo-Hanseatic war from 1469-74, which followed the seizure of Hanseatic goods in the London Steelyard in 1468, was a period of rising prices, during which Baltic trade virtually stopped, piracy increased and wax imports plummeted.[63] The contraction of trade did not have a serious effect on the ability of large institutions to

[60] Although Hanseatic privileges were still disputed: T.H. Lloyd, *England and the German Hanse, 1157-1611* (Cambridge, 1991), pp.50-61.
[61] Dollinger, *Hansa*, pp.291-293.
[62] Lloyd, *Hanse*, pp.175-199, 230; J.D. Fudge, *Cargoes, Embargoes, and Emissaries* (Toronto, 1995) p.18; Jenks, *England, die Hanse* vol. 2, pp.639-646; 700-709.
[63] S. Jenks, *England, die Hanse* vol. 3, p.996; E. Power and M.M. Postan, *Studies in English Trade in the Fifteenth Century* (London, 1933), p.34.

buy enough wax, however, and the Sacrists' accounts for these years do not show a decline in the amount of wax purchased. That the institutions were able to find enough wax, although at high prices, suggests that merchants kept significant stores of the product, although price increases in troubled years indicate that they were conscious of the sometimes fragile supply chain. With the restoration of trade following the Treaty of Utrecht in 1474, which reasserted Hanseatic privileges, wax imports—particularly into London—surged and prices fell.[64] The price volatility thereafter may reflect a turbulent period in the Hanse's relationship with the English and the Dutch. The decline in imports at the end of the period perhaps also reflects changing religious practice from 1532.[65]

The preference for imported wax in addition to the amounts of wax purchased suggests that distance from market, and that market's distance from a favoured port, would have affected the prices paid by the institutions. The closest port to Norwich was Yarmouth, connected to Norwich by the River Yare, and both it and more distant Lynn attracted Hanseatic merchants. In four years it is noted that New College bought wax in London, and the general omission of a place of purchase may suggest this was exceptional, necessitating an explanation in the accounts. Wax may have been more usually purchased in Oxford, which with its many colleges would have attracted a steady supply of sellers. Similarly, Winchester College preferred in the middle of the fifteenth century to buy wax in town and for a period of years from the same chandler who also made the candles.[66] The College's wax was also purchased in Salisbury, Southampton and London, with the

[64] Hanseatic cloth imports into England also increased substantially: A. Huang, *Die Textilien des Hanseraums. Produktion und Distribution einer spätmittelalterlichen Fernhandelsware* (Unpublished PhD thesis, University of Copenhagen, 2013), pp.361-366

[65] Fudge, *Cargoes*, p.19; Dollinger, *Hansa*, pp.193-4, 311-329. This agrees with Fudge's assessment that Hanseatic trade into London reflected political relations between England and the Hanse: Fudge, *Cargoes*, p.116. The Hundred Years War also threatened trade in the Channel for most of the period under consideration, altering the position and alliances of the Low Countries, the focus of much Hanseatic trade.

[66] For example WCM 22134-22146.

price of wax from London not regularly higher or lower than that bought in Winchester, although that purchased in Salisbury and Southampton was usually more expensive.[67]

The wax bought in Newcastle by Durham Cathedral Priory was likely shipped via Hull and transported north along the coast. This indirect route may explain the generally higher prices at Durham, as can the smaller but rather more captive market.[68] On the rare occasions when wax was bought in London and transported to Durham, the cost per pound was less than when it was bought in the north.[69] But distance from London alone cannot explain all of the difference in prices, given that both Canterbury Cathedral and Westminster Abbey bought wax in London every year, but Canterbury managed to acquire wax at routinely lower prices than Westminster.[70] Although the series are fairly well correlated with each other, Table 4 shows that no simple explanation can be given for the difference strengths of correlation. Why Canterbury and Durham are so strongly correlated, or the calculated prices for Westminster-Canterbury should be less strongly correlated than Westminster-Durham is unclear.[71]

Table 4: Correlation of prices of wax per pound between institutions (n), 1355-1556

Winchester				
Westminster	0.71 (61)			
Durham	0.63 (16)	0.55 (20)		
Canterbury	0.69 (33)	0.46 (28)	0.80 (10)	
	Winchester	**Westminster**	**Durham**	**Canterbury**

Source: As for table 2.

[67] For example WCM 2214, 22116, 22126, 22127, 22129, 22130,22132, 22151-22153, 22156-22157, 22162-2164. See also W. Harwood, 'Trade and consumption patterns in central Southern England: The supply of iron and wax to Winchester College c.1400-1560', *Southern History* 29 (2007), 1-28.

[68] For how price influenced purchases for the priory see M. Threlfall-Holmes, *Monks and Markets: Durham Cathedral Priory 1460-1520* (Oxford, 2005) pp.75-136, esp.89-102.

[69] In 1486/7, 442 pounds of wax were purchased at 7.27d./lb, including carriage from London, and in that same year 80 pounds were purchased in Durham for at 8d./lb: DCM Sacrist 1486/7.

[70] Similarly prices differed between institutions in the same place. In 1484/5 New College bought wax at 8d. and 10d., but Magdalen College paid 9d., 8d., and 7d.: New College Box 27/7743; Magdalen College Libri Compoti 1484/5.

[71] New College has been excluded for lack of overlapping years.

Relationships between buyer and seller were, it seems, based on factors other than simply acquiring the best price, and perhaps one component was the assurance that the institution would be able to buy as much wax as was needed without having to shop around.[72]

Although demand for wax in England was such that its supply became a major part of the eastern Hanseatic trade, this perhaps accounted for at most a fifth of the total amount of wax consumed for religious purposes before the explosion of wax imports from 1475.[73] Indeed, the minimum amount of wax needed in parishes alone exceeded the total alien imports into England in all but seven years before the Treaty of Utrecht, suggesting how very great domestic wax production must have been.

III.

Wax is, of course, a natural product.[74] Environmental factors, particularly temperature and precipitation, are fundamental in determining the health of bee populations, their food sources and habitats. The price series presented here do not cover the crisis years of the early fourteenth century, but some indication of the impact of weather on beekeeping in England may be found in the few instances of manorial accounts in which bees and

[72] E.g. in 1448/9 Winchester College bought 124 pounds wax at 4.74d./lb from Richard Philipp, but that same year purchased 152 pounds of wax at 6.43d./lb from John Kent, from whom the College bought most of its wax from 1446/7 to 1477/8. The following year the College purchased wax from Emmota Kent, presumably John's widow: WCM 22123, 22121-22147.

[73] E.g. in 1362/3 1,225 pieces of wax valued at 41620 marks of Lübeck (the equivalent of £10,388 sterling) was declared for customs at Thorn, and in 1369 1,666 pieces valued at 46,070 m.l. (£10,926): Jahnke, 'Baltic', p.218. Silver weights of m.l. from O. Volckart, 'Prices in Mark of Lubeck (14th to 16th century), International Institute of Social History: http://www.iisg.nl/hpw/mark_of_lubeck.php. Wax was the fourth largest commodity by value at Hamburg, a minor player in the wax trade, in 1369: H. Nirrnheim, *Das Hamburgishe Pfundzollbuch von 1369* (Hamburg, 1910), p.lvi. This very basic estimate assumes the majority of religious houses, cathedrals, colleges, hospitals, and mendicant orders in England over the period consumed relatively small amounts of wax each, averaging only one hundred pounds a year, and accepting the lowest boundary of parish church consumption. However it does assume that most wax was imported by aliens.

[74] For historical beekeeping practices see: E. Crane, *The World History of Beekeeping and Honey Hunting* (London, 1999); E. Crane, *The Archaeology of Beekeeping* (London, 1983); E. Crane, *A Book of Honey* (Oxford, 1980).

their products are noted. The stock accounts for Bishop of Winchester's manor of Ivinghoe (Bucks.) show how hard it could be to keep swarms alive: in 1315/16 all three of the manor's hives died; for the following three years no hives were entered into the accounts, and in 1320 both of the manor's hives died at Michelmas.[75] Manuscript illuminations show that bees were typically kept in woven skeps on raised platforms to keep them dry and away from animals.[76] This was not always enough to ensure that swarms were productive and safe, especially from water, and the 1407/8 proctor's accounts for the Durham Cathedral parish of Norham specifically notes that tithes of hives were not collected because of the numerous rains that year.[77]

Precipitation can affect bee populations positively, by encouraging the growth of pollen-producing plants, or negatively, by making the physical act of visiting plants difficult or by washing away pollen and discouraging plant growth. Since bees produce wax in order to store honey, environmental factors beneficial to honey production are also beneficial for the production of wax. Bees feed off honey as they cluster during the winter, and even when there is honey in the hive bees can starve over extended periods of very cold weather, if the cluster does not move to reach it. The colony itself also needs to be young and robust enough to survive the winter, and its health in early autumn affects its productivity the following year.

Lack of highly localized climate data makes analysis the effects of environmental factors on wax production difficult. This is particularly true of precipitation, which can vary dramatically over small regions. Yet the cooling trend of the fifteenth and sixteenth

[75] Hertfordshire Record Office (HRO) 11M59/B1/71; two hives are recorded in morina at Wycombe (Bucks.) in 1300/1: HRO 11M59/B1/66.
[76] For example compare Cambridge Trinity College MS R.14.9 f102v; Bodleian MS Ashmole 1511 f75v; Bodleian MS Douce 88 f111v with the Exultet rolls; see also Fitzherbert, *The Book of Husbandry*, ed. W. Skeat (London, 1882), p.76.
[77] DCM Norham Accounts 1407/8; thanks to Ben Dodds for this reference.

centuries, the beginning stages of the Little Ice Age, is so well known that the relationship between temperature and wax prices merits some consideration.[78] Figure 4 compares northern hemisphere temperatures with the Westminster price series, which provides the greatest number of annual averages, and a composite average from the churchwardens' accounts. The temperature and Westminster price data are shown in 10-year moving averages, but annual averages have been used for the less robust parish data.

Figure 4: Westminster and parish wax prices and northern hemisphere temperature 1383-1532

Source: C.M. Ammann and E.R. Wahl, 'The importance of the geophysical context in statistical evaluations of climate reconstruction procedures', *Climate Change* 85 (2007), 71-88; WAM 19623-19807. Parish church prices are from the churchwardens' accounts of Bishop's Stortford (Herts.), Halesowen (Worcs.), Mildenhall (Suffolk), Pilton (Somerset), St Edmund Sarum, St Thomas Sarum, St Nicholas Strood (Kent), St Mary's Cambridge, St Mary's Dover, Walberswick (Suffolk). See works cited for full bibliographic information. Silver weights: as for figure 2.

Although it appears that there was perhaps something of a negative relationship between temperatures and prices, vector autoregression analysis (VAR) of the data sets shows no

[78] B.M.S. Campbell, *The Great Transition: Climate Disease and Society in the Late-Medieval World* (Cambridge, 2016), pp.336, 344-49, 366, 371-3.

significant relationship between temperature and prices.[79] There may be several reasons for this surprising result.

Years may have passed from the time wax was collected and when it arrived in England from the Hanseatic *kontors*, making it difficult to know when the wax purchased in a particular year was produced. The absence of accounts from Novgorod, a major centre of the wax trade, means that the total amount of wax brought to its *kontor* each year cannot be calculated.[80] Political disturbance affected the amount of wax imported into England, which must have complicated the relationship between climate and prices. It is likely too that in years when imported wax became scarce wealthy buyers bought domestic wax, driving up prices in both sectors. Similarly, the influx of low-price imports at the end of the period may have driven down domestic prices.

Yet climate must have had some effect on bee productivity, as the anecdotal evidence from English records shows. The counter-intuitive lack of a statistically significant relationship between temperature and wax prices suggests a complex interplay between climate and the production and price of natural commodities in this period, which deserves further study.

[79] Unit-root tests (standard and augmented Dickey-Fuller, and Phillips-Perron) confirmed the temperature series to be level stationary and the price series stationary after first differencing. VAR showed no statistically significant relationship between temperature and the wax prices. The length of the lag was determined by using Akaike information criteria which suggested one lag. The estimated coefficient was 0.2605327, standard errors 0.7118717, corresponding p-value 0.714. A Granger causality test also showed no significant effect of temperature on prices. The Granger causality Wald chi-square was 0.13394 (p-value 0.714). I am grateful to Alex Klein for this statistical analysis.

[80] Jahnke, 'Baltic', p.220; on Novgorod see L.K. Goetz, *Deutsch-russische Handelsgeschichte des Mittelalters* (Lübeck, 1922), pp.259-272.

IV.

Domestic supply is much more difficult to quantify than foreign imports. Manorial accounts, which record the income and expenditure of seigneurial agriculture in great detail, are almost wholly silent regarding production in apiaries. The account book of Beaulieu Abbey from c.1270 is exceptional in this respect, recording amounts of wax and honey received from various parts of its estates. Table 5 also shows the amount of honey expended feeding the bees over the winter, necessary to keep bees alive if supplies in the hive were insufficient.

Table 5: Wax and honey produced on the estates of Beaulieu Abbey, c.1270

Place	**Wax (lbs)**	**Honey (gal.)**	**Feeding bees honey (gal.)**
Kindelwere (Oxon.)		6	
Wyke (Oxon.)	2.5	3	
Coxwell (Oxon.)		4	
St Keverne (Corn.)	1.5		
Soberton (Hants.)	6		
Colbury (Hants.)		3	0.5
Holbury (Hants.)	9	2	1
St Leonards (Hants.)	13.5	12	
Beufre (Hants.)	20	27	2
Hartford (Hants.)	13.5	4	2
Otterwood (Hants.)	22	13	
Tanner and shoemaker	6	2	1
Orchard	2	1	1
Sacrist [a]	10	8	1
Kitchen garden	10	6	
Garden	2	1	0.5
Curtilage of infirmary	25	8	2
Forge	42	9	3

Source: *The Account-Book of Beaulieu Abbey*, ed. S.F. Hockley (London, 1975); all figures are from the livestock accounts.

[a] The Sacrist also received 140 pounds of wax from the minor camera valued at 6d. per pound and 8.5 pounds in oblations.

In good years a skep may have produced about a pound of wax, although in bad years skeps were flooded, swarms died, and wax production was severely curtailed.[81] At the

[81] E. Lamond (ed., trans.) *Walter of Henley* (London, 1890) p.81. Honey to wax ratios were variable: At the Arundell manor of Hartland (Devon) in 1403/4 and 1405/6 one gallon of honey and 1.5 pounds of wax were collected from the lord's bees, while in 1407/8 one gallon of honey and one pound of wax were collected and five years later the same ratio was recorded, this time 1.5 gallons of honey and 1.5 pounds of wax: Cornwall Record Office (CRO) AR2/542 m.4, AR2/542 m.6, AR2/542 m.8. The amounts suggest

Bishop of Winchester's manor of Ivinghoe (Bucks.) 7 gallons of honey and wax were received from the manor's bees in 1310/1, but the cold, wet years of the second decade of the fourteenth century clearly took their toll: in 1315/6 all three of the manor's hives died and no wax or honey was produced until 1320/1 when the manor managed to keep two hives alive over the winter. By the middle part of the fourteenth century bees were no longer recorded in the stock accounts of the manor.

While the number of skeps in the country cannot be calculated, domestic beekeeping must have been widespread. Almost 1400 hives are noted in Little Domesday, which covers Essex, Norfolk and Suffolk, while the detailed returns of the 1225 lay subsidy for the wapentake of Aswardhurn (Lincs.) and the deanery of Chalk (Wilts.) record 86 hives owned by 31 people and 277 hives owned by 115 people respectively.[82] Entries regarding exported honey in petty customs accounts are also suggestive of extensive domestic beekeeping.[83]

Stipulations in custumals regarding tithed honey and the occasional (although often blank) entry for tithed hives in manorial accounts further demonstrate that beekeeping was common across the country.[84] Some people kept several hives, indicated in wills such

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the produce of one hive, short of Walter's thirteenth-century estimates, but more than that at Ivinghoe in the early fourteenth century, where one pound of wax and no honey was received from the three hives recorded in morina in 1315/6: HRO 11M59/B1/71.

[82] A further 70 settlements owed honey renders TRE: A. Williams and G.H. Martin (eds.) *Domesday Book* (London, 2003). F.A. Cazel and A.P. Cazel, *Rolls of the Fifteenth of the Ninth Year of the Reign of Henry III for Cambridgeshire, Lincolnshire and Wiltshire and Rolls of the Fortieth of the Seventeenth Year of the Reign of Henry III for Kent* (London, 1983).

[83] E.g. D.M. Owen, *The Making of King's Lynn: A Documentary Survey* (London, 1984) pp.342-377 in which all wax was imported and all honey was exported and W.R. Childs, *The Customs Accounts of Hull, 1453-1490* (Leeds, 1986) which shows a similar pattern, although small amounts of wax were exported.

[84] Not every household kept bees—only 4 hives were tithed in the parish of Norham in 1408/9, which included 14 townships: DCM Norham 1408/9. On honey see for example: 'Custumal of the Sussex Manors of the Archbishop of Canterbury Manors', ed. B.C. Redwood and A.E. Wilson, *Sussex Record Society* 57 (1958) p.37; *Cartularium Monasterii de Rameseia* ed. W.H. Hart and P.A. Lyons (London, 1884-1893) vol. 1 p.302 (Holywell), vol. 3 p.225, 231 (Sitlington); p.270 (Upwood), p.271 (Hecmundgrave). See also P. Walker and E. Crane, 'English beekeeping from c.1200-1850: Evidence from local records', *Local Historian* 31 (2001), 3-30.

as that of Thomas Pake of Stephyngton, who in 1530 left six hives to four people plus 5 pounds of wax to the church. Similarly, John Lord left his wife three hives in 1529/0, and John Russell left four hives to two of his children and 3.5 pounds wax to church in Stephyngton in 1529.[85]

A resourceful approach to maintaining an adequate supply of wax was taken at Arlington (Sussex) in the mid-fifteenth century, where cows were rented out in return for two pounds of wax per cow per year. In 1457, 28 cows were rented out for a year each, along with one cow for half a year, for a total of 57 pounds of wax. In 1475 it was recorded that 116 pounds of wax were received for rents of 29 cows for two years, 108 pounds of which were used for the lights of the church.[86] The churchwardens thus acquired a steady supply of wax while insulating themselves from the price fluctuations of the period. How the wax paid to the church was itself acquired cannot be known, but such small, fixed amounts may suggest that the wax was the result of domestic beekeeping, and two hives would have produced enough wax to cover this expense.

That there were small suppliers of both honey and wax is indicated in accounts of the Arundel estates in Cornwall and the obedentiary accounts of Durham Cathedral.[87] For the thousands of parish churches which provided for the poor and which were reliant on small gifts and low incomes, a steady supply of domestic wax could have kept candles burning while providing additional income for small producers, and in good years each

[85] P. Bell, 'Bedfordshire Wills, 1484-1533', *Bedfordshire Historical Record Society* 76 (1997), p.82, 137, 167, 170.
[86] BL Add MS 33192 f14r.
[87] CRO AR2/549, AR2/550 m.3; DCM Cellarer's Accounts 1337/8-1348/9; see also Statutes of the Realm 23 Eliz. C.8.v.; increasing demand is perhaps indicated by the creation of the wax chandlers' guild at London, which existed from the fourteenth century, and was incorporated in 1484. Accounts only survive from the sixteenth century: Dummelow, *Wax Chandlers*, p.1, 26.

skep could have yielded perhaps 2s. before the deduction for the tithe.[88] The numerous female recipients of hives in wills suggest that beekeeping was often women's work, and given the circumscribed economic opportunities available to women, the income from hives would have been particularly valuable. The wardens' accounts show that women both supplied wax and made candles for parish churches.[89]

V.

There must then have been a dual economy for wax. The requirements of larger institutions, in terms of quantity and quality, tended to favour imported wax, while those of parish churches favoured the domestic wax of small-scale local producers.

The association of foreign wax with wealth is seen not only in the Sacrists' accounts, but in the Crown's outrage in 1309, when Hanseatic merchants were accused of increasing prices by not importing wax, and seven merchants were brought to account for action 'in contempt of the king'.[90] The strict quality control of this wax may have been a deciding factor, because greater purity (itself symbolically important) would have made whiter, cleaner wax. Large religious houses were reliant on large purchases of other luxury items, including spices and wine, which necessitated trips to large cities—often London—where imports were readily available. The presence of domestic wax does not appear to have depressed prices of imported wax: Winchester purchased 23 pounds of English wax in 1477/8 for 5.5d per pound from Henry Feston, but in the same year the College

[88] Assuming honey at 8-12d./gal.: DCM Bursar Cellarer's Indentures; DCM Cellarers Accounts; DCN Cellarer's Accounts 1/1/3-43; CRO AR2/544/2-6, AR2/549, AR2/550-1; E. Searle, ed., *The Cellarers' Rolls of Battle Abbey: 1275-1513* (Lewes, 1967); wax average 5.5d/lb: a hive producing 2 gals and 1 lb wax would yield 21-29.5d.

[89] E.g. Swayne, *St. Edmund and St. Thomas*, p.30; F. Somers, ed., *Halesowen Churchwardens' Accounts, 1487-1582* (London, 1957), pp.24, 34. See also French, *Women of the Parish*, p.35.

[90] K. Kunze, *Hanseakten aus England, 1275-1412* (Halle, 1891), p.35-6.

purchased 233 pounds of wax de Polane for 6d. per pound from its usual provider, John Kent.[91]

At the other end of the spectrum, demand for wax from parish churches would have provided a ready market for local beekeepers. Small purchases from local producers may have been a convenience for parish churches. These did occasionally buy imported wax, but this is rarely explicitly stated.[92] Despite a lack of written evidence, the forgoing discussion has demonstrated how common beekeeping must have been in England, and we must assume that parish churches took advantage of the markets nearest to them without having to bear further transport and transaction costs.

VI.

Over the later Middle Ages, highly affective Christocentric forms of devotion developed, emphasizing the role of holy images and lavish celebration of the Virgin Mary and the life of Christ. This became especially prominent in the aftermath of the Black Death and, in England, in the era of heightened mortality it heralded. The practices that developed from these trends in Christian theology were reliant on the adequate supply of large quantities of beeswax, for they were dependent on the provision of light.

Yet wax prices were often volatile, with a distinct decline over the period. Near-constant conflict between Hanseatic merchants and their suppliers, customers, territorial lords, and each other meant that the supply of wax was not always assured. The effects of war, as well as peace, can be seen in the price series. High demand for diminished supplies kept wax prices buoyant even in the years of bullion famine and economic stagnation of

[91] WCM 22147.
[92] E.g. at Halesowen (Worcs.) 16.5 pounds of 'Pollen' wax was bought in 1488/9: Sargeant, *Halesowen*, p.74.

the mid-fifteenth century. But wax production was dependent on environment too, and further research is needed to test the effects of climate and weather on wax production and cost.

The particular preferences of late medieval Christian devotion combined with environmental, demographic and economic factors to drive a thriving European-wide trade in wax. Bees were at once natural resources vulnerable to environmental change and sources of symbolic inspiration, part of both small-scale household economies and trans-European exchange. This research has begun to reveal the economic impact of religious devotion across medieval Europe, and how cultural preferences brought otherwise economically peripheral areas into the heart of European trade. In the scale of wax consumption we see the importance of the bee to the medieval economy.

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Bees in the medieval economy: religious observance and the production, trade, and consumption of wax in England, c.1300-1555

Appendix A: Nominal prices per pound of wax calculated from total in accounts, in d.[a]

	Canterbury	Durham	New Coll.	Norwich	Westminster	Winchester
1274				4.62		
1277				5.49		
1284				5.21		
1288				4.90		
1290				4.79		
1291				5.12		
1293				6.07		
1297				7.05		
1300				7.90		
1301				5.52		
1304				7.65		
1305				6.92		
1307				7.57		
1314				6.58		
1318		6.67				
1320				6.27		
1322				5.53		
1323				4.45		
1325				5.47		
1329				6.78		
1331				7.17		
1333				6.39		
1334				6.10		
1335				5.96		
1336				5.36		
1338					5.75	
1340				6.37		
1343				5.02		
1354		7.18				
1355					6.00	
1356		6.91				
1359					6.75	
1360		8.33				
1361		7.53				
1362		8.09				
1365				6.23	5.68	
1373					5.68	
1374					6.38	
1375	7.14				7.29	
1377		7.99				
1378		7.73			6.11	

1379		7.75			5.75	
1380		8.44				
1381		6.79				
1382		6.02				
1383		5.94	7.00		5.25	
1384		5.87				
1386		5.00			5.04	
1387					5.14	
1388					5.14	
1389		5.98	4.94		5.14	
1390			5.05		5.36	
1391		5.98	4.17		5.46	
1392					5.04	
1393	5.89		4.24		5.14	
1394	5.79	5.45	5.58		5.84	
1395					5.81	5.42
1396		5.78			5.64	6.48
1397		5.78			5.57	
1398		7.80			6.21	5.80
1399			6.39			5.91
1400	4.82				5.70	6.00
1402		7.00				
1403		5.33	5.12			
1406						5.21
1407		6.07				
1408		6.00			5.03	5.50
1409		5.42	4.80			
1410			4.77			4.93
1411						5.50
1412	4.82	5.53	5.75			5.27
1413	6.00		5.20			5.57
1414						5.92
1415		6.60	5.50			5.99
1416	5.67					6.08
1417		5.94				6.04
1418			5.50	5.68		
1419			5.00			5.15
1420		5.00				
1421			4.75	4.17		
1422	5.08	5.68				
1423	4.02	4.00			4.39	
1424	4.02	5.39				5.07
1425	4.93		4.43		4.39	4.55
1426			5.00		5.64	
1427					5.69	7.03
1428			6.92		6.00	

1429	5.42				5.79	
1430	5.00					
1431					4.71	5.80
1432					5.01	5.07
1433					5.12	5.91
1434					4.37	4.53
1435			5.00		4.36	4.29
1436						
1437	4.22		4.92		4.58	4.36
1438					4.57	4.70
1439		4.50		4.75	4.77	4.71
1440		5.52		5.51		5.73
1441		5.42	8.00		6.94	6.31
1442	6.61	6.53		6.38	7.10	7.30
1443	6.43	6.39	6.54			6.57
1444	4.81	4.53				5.67
1445	4.39	4.34	5.00		4.71	4.49
1446	4.82	4.44			4.75	
1447	5.14					6.97
1448						4.74
1449	5.08		5.76			5.58
1450	5.36		6.43			6.00
1451	5.56				6.00	5.61
1452						5.25
1453	4.93		4.59		6.00	5.52
1454					5.46	4.43
1455			5.75			4.57
1457	4.82				5.36	5.13
1458					5.36	5.41
1459					5.57	
1460					5.36	5.26
1461	4.64		5.25			
1462						5.00
1463	4.50				4.96	
1464	4.71				5.36	
1465	6.21		6.00	5.93	6.17	6.60
1466			7.00	6.50	6.41	6.13
1467					5.93	6.78
1468	6.43					7.14
1469	6.43					7.50
1470	6.79		7.50	6.96		6.96
1471	7.14				6.50	7.31
1472	7.14			7.58	7.11	8.57
1473						6.86
1474		7.21		7.01	6.22	6.90
1475	6.43			6.00	5.24	

1476					5.14	5.90
1477					4.51	6.19
1478				4.94	5.11	5.48
1479					4.57	5.88
1480			4.98			5.55
1482				5.78	4.64	4.84
1484		5.99		5.14		
1485			9.50	7.11	7.74	7.30
1486					6.77	
1487					6.16	
1488			8.00		6.32	
1489			6.43		6.43	
1490					5.67	7.31
1491					8.63	
1492					6.36	7.06
1493					6.05	7.75
1494	5.00				6.43	7.50
1495				6.81	6.70	7.96
1496	3.73				6.55	6.41
1497			5.47		5.15	
1498					5.46	
1499	4.99				5.34	
1500	5.00				4.82	6.00
1501	5.00				5.62	6.00
1502					6.11	7.00
1503					5.04	
1504					5.14	5.54
1505				4.45	5.03	5.80
1506				4.45	4.71	
1507	5.00				4.72	
1508	3.52				4.87	3.55
1509	5.00					4.63
1510	4.64					5.05
1511	5.00			7.50		6.01
1512				5.71	5.80	5.71
1513					5.36	5.00
1514				5.50	5.70	
1515					6.22	6.07
1516				7.21		7.14
1517						6.34
1518				6.43	7.19	6.71
1519			8.70			7.96
1520	4.44					
1521	5.00				8.22	8.24
1522					8.57	10.42
1523					8.76	

1524					6.59	
1525					6.54	6.38
1526				5.73	6.44	5.71
1527					5.81	5.00
1528					6.00	4.88
1529					4.95	4.73
1530					4.55	
1531						8.38
1532	5.00			5.48	4.58	5.85
1533						5.35
1535				6.43		6.65
1536		8.00				6.39
1537						4.86
1539						6.00
1541						8.22
1543						4.92
1544						4.29
1545						4.46
1546						5.57
1548						6.90
1549						6.37
1555						8.00
1556						9.33

[a] Total amounts of wax calculated using 108 pounds per hundredweight until 1340 and 112 pounds thereafter, with the exception of Durham, where a long hundred of 120 pounds was sometimes used to record the weight of wax. At Canterbury the use of the hundredweight for the price is explicit, but not for the weight. However, using the hundredweight only for the cost and not for the weight of wax leads to a much larger and more constant disparity between the price of wax calculated from the total and that given. Using a short hundred does not resolve the problem. The Canterbury prices have therefore been calculated assuming a hundredweight of 112 for both weight and price.

Appendix B: Nominal prices per pound of wax given in accounts, in d. [a]

	Canterbury	Durham	New Coll.	Norwich	Westminster	Winchester
1288				4.89		
1318		6.67				
1338					5.75	
1355					7.07	
1357		7.25				
1359					7.29	
1373					5.68	
1374					6.38	
1375	7.14				7.29	
1378					6.11	

1379					5.73	
1383					5.30	
1386					5.04	
1387					5.14	
1388					5.14	
1389			5.63		5.14	
1390			5.50		5.36	
1391			4.25		5.43	
1392					5.57	
1393	5.89		4.63		5.14	
1394	5.79		5.75		6.13	
1395					5.81	7.00
1396					5.64	5.96
1397		6.00			5.57	
1398		5.50			6.21	
1399			7.50			
1400					5.70	
1403		5.34	5.13			
1404						6.00
1406		6.04				
1407			5.18			5.00
1408		6.00			5.04	5.50
1409		5.38	5.20			
1410		5.50	4.75			4.75
1411						5.50
1412	4.82	5.50	5.28			
1413		5.25	5.19			5.57
1414		6.00				6.63
1415			5.50			
1416		6.50				
1417		6.00				
1418			5.50	5.68		
1419			5.00			
1420		5.00				
1421			4.75			
1422		5.00				
1423		4.00			4.39	
1424		5.00				
1425		5.00	4.45		4.39	
1426					5.64	
1427					5.69	5.75
1428			6.92		6.00	
1429					5.79	
1431					4.71	
1432					4.50	5.04
1433					4.61	

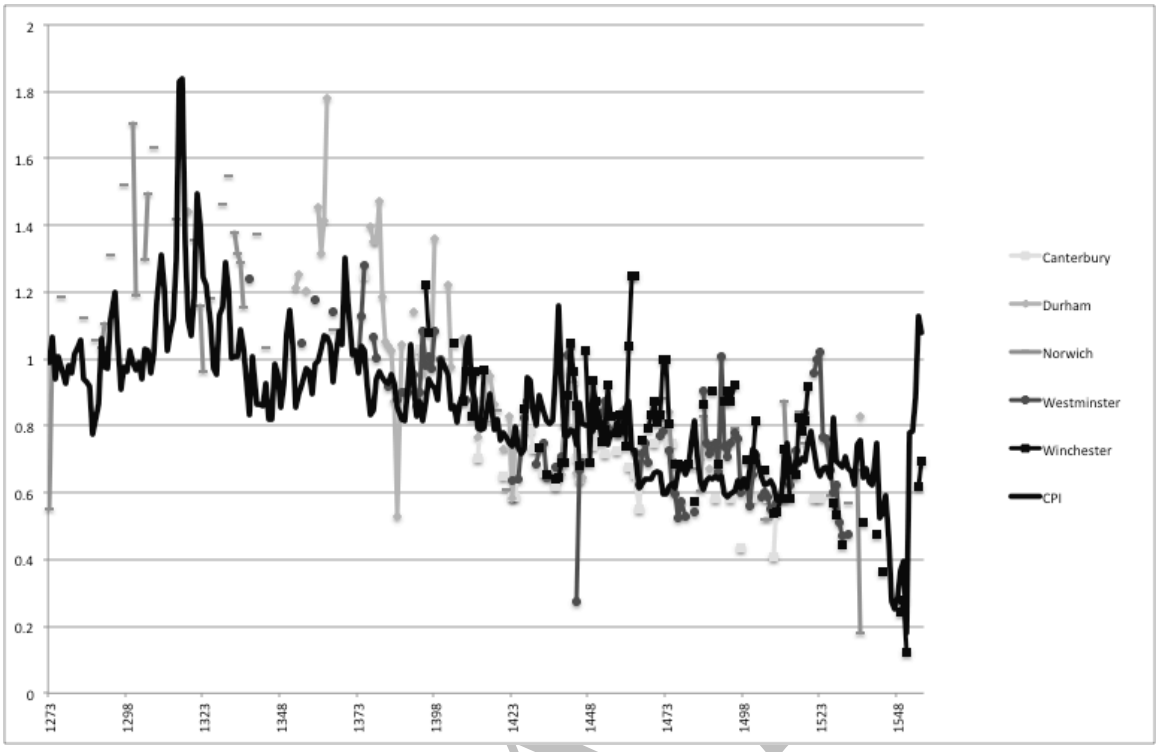
1434					4.41	4.50
1435			5.00		4.36	
1437			4.92		4.54	4.39
1438					4.57	4.70
1439		4.50			4.76	4.71
1440		5.50				4.73
1441			8.00	6.43		6.28
1442	6.61			6.43	7.14	7.30
1443	5.36		6.54			6.56
1444	4.82					5.76
1445	4.39		5.00		4.54	4.50
1446	4.82					
1447	5.14	7.25				7.03
1448						4.75
1449	5.14					5.31
1450	5.36					6.00
1451	5.68				6.00	5.55
1452						5.24
1453	4.93		5.86		6.00	5.00
1454					5.46	5.50
1455			5.75			5.61
1456					5.57	
1457	4.82				5.36	5.13
1458					5.36	5.50
1459					5.57	
1460					5.36	5.25
1461	4.61					
1462						5.00
1463	4.61				4.93	
1464	4.71				5.36	
1465	5.89		6.00		6.16	6.71
1466					6.26	
1467					6.32	6.79
1468	6.43					7.14
1469	6.43					7.50
1470	6.77		7.50			6.96
1471	7.11				6.50	7.14
1472	7.14				7.11	8.57
1473	5.00	8.75				8.57
1474	6.43	7.00			6.22	6.79
1475	6.43	6.58			5.24	
1476					5.14	5.89
1477					4.51	5.89
1478					4.69	5.50
1479					4.57	5.89
1480			5.00			5.89

1482					4.64	4.91
1484		6.00	6.00			
1485		7.33	9.50		7.51	7.25
1486		8.33			6.86	
1487		8.50			5.46	
1488		8.13	8.00		6.32	
1489			6.43		6.32	
1490					5.57	
1491					6.25	
1492					6.36	7.50
1493					6.05	7.75
1494	5.00				6.43	7.50
1495					6.00	7.93
1496					5.89	
1497			5.46		5.14	
1498					5.14	
1499	5.00				5.14	6.00
1500					4.82	6.00
1501	5.00				5.71	6.00
1502					6.11	7.00
1503					4.50	
1504					5.04	
1505				4.89	5.04	5.71
1506			4.64	4.89	4.71	
1507					4.71	
1508	5.00				4.93	4.62
1509	5.00					4.64
1510						5.00
1511	4.64			7.50	5.71	5.36
1512				5.71	5.79	5.71
1513					5.36	5.00
1514				5.50	5.68	
1515					6.21	5.63
1516				6.50	6.79	7.07
1517						6.59
1518				6.50	7.14	7.00
1519				8.57		7.88
1520					8.18	
1521					8.21	
1522					8.57	
1523					8.75	
1524					6.71	
1525					6.54	
1526				5.68	6.43	
1527					5.79	5.50
1528					6.00	5.14

1529		4.61	
1530		4.55	4.26
1532		4.55	
1536	8.00		
1537			4.93
1541			4.61
1543			5.00
1549			7.00
1550			8.00
1551			7.00
1555			8.00
1556			9.00

[a] As for Appendix A

Appendix C: Indexed price per pound of wax calculated from total, in silver, and CPI



Source: CPI and silver from R.C. Allen 'Prices and wages in London & southern England, 1259-1914', *Consumer Price Indices*, International Institute of Social History: http://www.iisg.nl/hpw/data.php#europe (accessed 18 December 2016).

For wax prices see text. 1400=1.

Appendix D: Account dates for Figure 3, Alien wax imports at major wax-importing ports, 1303-1547

No accounts 1312-1321; 1344-1351; 1373-4; all years are 29 Sept-29 Sept except those noted below:

Boston: No accounts 1373-1377; 1404-1407; 1409-1413; 1421-2; 1440-1503; 1515-1517. 1310/1 is 29 Sept-27 Oct; 1323/4 is 24 Oct-29 Sept; 1326/7 is 23 Aug-29 Sept; 1327/8 is 20 Apr-20 Apr; 1328/9 is 20 Apr-20 Apr; 1329/0 is 7 May-1 May; 1330/1 is 1 May-10 Jun; 1331/2 is 10 Jun-29 Sept; 1331135/6 is 29 Sept-23 Aug; 1339/0 is 29 Sept-16 Jul; 1342/3 is 16 Jun-15 Jul; 1363/4 is 29 Sept-2 Oct; 1364/5 is 2 Oct-20 Oct; 1365/6 is 20 Oct-29 Sept; 1371/2 is 29 Sept-24 Dec; 1377/8 is 26 Aug-29 Sept; 1386/7 is 29 Sept-1 Jul; 1387/8 is 26 Nov-29 Sept; 1400/1 is 29 Sept-2 Oct; 1402/3 is 2 Oct-2 Oct; 1403/4 is 2 Oct-3 Oct; 1407/8 is 29 Sept-24 Jul; 1419/0 is 29 Sept-10 Oct; 1422/3 is 1 Sept-29 Sept; 1427/8 is 29 Sept-24 Nov; 1428/9 is 24 Nov-1 Nov; 1429/0 is 1 Nov-1 Nov; 1430/1 is 1 Nov-1 Nov; 1431/2 is 20 Oct-29 Sept; 1435/6 is 30 Sept-10 Oct; 1436/7 is 10 Oct-11 Nov.

Hull: No accounts 1321/2; 1333-1336; 1339-1340;1342-1343; 1374/5; 1444-1453; 1457-1485. 1304 is 1 Apr-29 Sept; 1322/3 is 20 Jul-30 Sept; 1323/4 is1 Oct-1 Oct; 1326/7 is 29 Sept-8 Feb; 1340/1 is 29 Sept-11 May; 1364/5 is 29 Sept-10 Oct; 1365/6 is 10 Oct-10 Oct; 1366/7 is 10 Oct-29 Sept; 1372/3 is 29 Sept-4 Nov; 1376/7 is 21 Jun-26 Aug; 1377/8 is 26 Aug-29 Sept; 1384/5 is 2 Dec-29 May; 1397/8 is 21 Sept-29 Sept; 1400/1 is 3 Dec-22 Jul; 1401/2 is 22 Jul-29 Sept; 1402/3 is 13 May-29 Sept; 1421/2 is 29 Sept-31 Aug; 1422/3 is 1 Sept-29 Sept; 1453/4 is 4 Nov-29 Sept; 1455/6 is 1 Oct-19 Oct; 1485/6 is 22 Aug-29 Sept; 1494/5 is 29 Sept-22 Aug; 1501/2 includes denizen imports; 1515/6-1516/7 includes denizen imports.

Ipswich: No accounts 1321/2; 1328-1386; 1388-1394; 1396-1399; 1405-1406; 1413/4; 1451-1452; 1459-1460; 1468-1474; 1484-1486; 1499-1502; 1504-5; 1507-1510; 1512-1517. 1310/1 is 29 Sept-9 Oct; 1322/3 20 Jul-1 Oct; 1323/4 is 1 Oct-29 Sept; 1386/7 is 4 May-11 Jun; 1395/6 is 18 Oct-22 Nov; 1399/0 is 10 Oct-21 Nov; 1400/1 is 21 Nov-17 Oct; 1401/2 is 17 Oct-2 My; 1402/3 is 3 May-6 Apr; 1403/4 is 6 Apr-20 Jan; 1407/8 is 29 Sept-24 Jul; 1408/9 is 24 Jul-29 Sept; 1416/7 is 29 Sept-17 Oct; 1422/3 is 1 Sept-29 Sept; 1432/3 is 29 Sept-18 Oct; 1434/5 is 29 Sept-4 Oct; 1435/6 is 4 Oct-29 Sept; 1447/8 is 29 Sept-16 Oct; 1448/9 is 16 Oct-2 Jul; 1449/0 is 2 Jul-29 Sept; 1453/4 is 29 Sept-29 Nov; 1454/5 is 29 Nov-29 Sept; 1455/6 is 29 Sept-22 Oct; 1456/7 is 22 Oct-29 Sept; 1457/8 is 29 Sept-29 Nov; 1461/2 is 29 Sept-16 Oct; 1463/4 is 10 Jul-31 Aug; 1464/5 is 31 Aug-29 Sept; 1474/5 is 29 Sept-8 Nov; 1475/6 is 8 Nov-8 Nov; 1476/7 is 8 Nov-8 Nov; 1477/8 is 8 Nov-7 Nov; 1478/9 is 8 Oct-14 Oct; 1479/0 is 14 Oct-29 Sept; 1480/1 is 14 Oct-29 Sept; 1490/1 includes denizen; 1492/3 includes denizen imports; 1494/5 includes denizen imports; 1502/3 includes denizen imports; 1511/2 is 27 May-29 Sept. and includes denizen imports.

London: No accounts 1302/3, 1304/5; 1321/2; 1395/6; 1448/9; 1470/1; 1495-1496; 1516/7. 1303/4 is 10 Feb-31 Mar; 1304-6 combined 1 Apr-24 Jun; 1306/7 is 24 Jun-29 Sept; 1322/3 is 20 Jul-29 Sept; 1342/3 is 29 Sept-20 Jul; 1351/2 is 4 Nov-29 Sept; 1371/2 is 29 Sept-24 Dec; 1375/6 is 23 Apr-29 Sept; 1380/1 is 5 Sept-6 Sept; 1382/3 is 6 Sept-7 Sept; 1383/4 is 29 Sept-3 Jul; 1384/5 is 3 Jul-29 Sept; 1388/9 is 29 Sept-5 Sept; 1389/0 is 25 May-29 Sept; 1391/2 is 29 Sept-8 Aug; 1392/3 is 8 Aug-29 Sept; 1396/7 is 10 Dec-29 Sept;

1398/9 is 29 Sept-6 Oct; 1399/0 is 6 Oct-29 Sept; 1421/2 is 29 Sept-31 Aug; 1477/8 is 8 Jan-21 Jul; 1448-50 combined 21 Jul-10 Mar; 1452/3 is 6 May-29 Sept; 1454/5 is 29 Sept-8 Jun; 1455/6 is 8 Jun-22 Oct; 1456/7 is 22 Oct-29 Sept; 1457/8 is 29 Sept-2 Sept; 1458/9 is 2 Setp-29 Sept; 1459/0 is 29 Sept-31 Jul; 1460/1 is 31 Jul-4 May; 1461/2 is 29 Sept-16 Oct; 1462/3 is 16 Oct-29 Sept; 1463/4 is 29 Sept-5 Dec; 1464/5 is 5 Dec-29 Sept; 1468/9 is 29 Sept-6 Nov; 1469/0 is 8 Nov-9 Oct; 1471/2 is 29 Sept-4 Aug; 1472/3 is 4 Aug-29 Sept; 1476/7 is 29 Sept-20 Nov; 1477/8 is 20 Nov-9 Jul; 1478/9 is 9 Jul-29 Sept; 1482/3 is 29 Sept-24 Jul; 1483/4 is 24 Jul-29 Sept; 1485/6 is 21 Aug-10 Dec; 1486/7 is 10 Dec-16 Jul; 1502/3 includes denizen imports.

Lynn: No accounts 1321/2; 1352-1378; 1380-1392; 1394/5; 1402-1405; 1458-1463; 1468-1473; 1486-1487; 1506-1517. 1303 is 10 Feb-29 Sept; 1303/4 is 10 Oct-29 Sept; 1310/1 is 29 Sept-9 Oct; 1322/3 is 20 Jul-1 Oct; 1327/8 is 23 Apr-29 Sept; 1341/2 is 10 Mar-11 Mar; 1342/3 is 11 Mar-15 Apr; 1378/9 is 8 Feb-10 Apr; 1392/3 is 2 Apr-6 Apr; 1393/4 is 6 Apr-29 Sept; 1394-6 combined 29 Sept-12 Feb; 1396/7 is 12 Feb-29 Sept; 1399/0 is 29 Sept-12 Oct; 1400/1 is 12 Oct-15 Feb; 1406/7 is 5 Apr-29 Sept; 1421/2 is 29 Sept-31 Aug; 1422/3 is 1 Sept-29 Sept; 1426/7 is 23 Oct-29 Sept; 1432/3 is 29 Sept-9 Nov; 1433/4 is 10 Nov-29 Sept; 1436/7 is 29 Sept-11 Nov; 1437/8 is 11 Nov-29 Sept; 1450/1 is 29 Sept-10 Jul; 1452/3 is 12 May-1 Jun; 1453/4 is 1 Jun-3 Apr; 1454/5 is 3 Apr-8 Apr; 1455/6 is 8 Apr-6 Mar; 1456/7 is 6 Mar-29 Sept; 1463/4 is 12 Jul-19 Nov; 1464/5 is 19 Nov-19 Nov; 1465/6 is 19 Nov-2 Nov; 1473/4-1479/0 13 Nov-13 Nov; 1480/1 is 13 Nov-29 Sept; 1484/5 is 29 Sept-22 Aug.

Newcastle: No accounts 1302/3; 1322-1368; 1370-1376; 1378-1397; 1398/9; 1423-1425; 1437/8; 1454-1494; 1503-1517. 1304 is1 Apr-29 Sept; 1310/1 is 29 Sept-9 Oct; 1376/7 is 21Jun-21 Jun; 1396/7 is 8 Sept-15 Apr; 1398/9 is 15 Apr-23 Apr; 1400/1 is 23 Apr-29 Sept; 1402/3 is 29 Sept-16 Nov; 1403/4 is 16 Nov-24 Jul; 1404/5 is 24 Jul-23 Apr; 1405/6 is 23 Apr-25 Dec; 1407 is 20 Feb-29 Sept; 1407/8 is 29 Sept-7 Sept; 1408/9 is 7 Sept-7 Sept; 1408/9 is 7 Sept-10 May; 1409/0 is 10 May-27 Sept; 1410/1 is 27 Sept-30 Sept; 1420/1 is 29 Sept-12 Sept; 1421/2 is 12 Sept-31 Aug; 1431/2 is 29 Sept-15 Jul; 1432/3 is 15 Jul-29 Sept; 1436/7 is 29 Sept-25 Dec; 1442/3 is 29 Sept-31 Aug; 1443/4 is 31 Aug-29 Sept; 1448/9 is 29 Sept-22 Dec; 1449/0 is 22 Dec-29 Sept; 1452/3 is 29 Sept-31 Aug; 1494/5 is 1 May-2 Dec; 1495/6 is 2 Dec-29 Sept; 1494-1501 includes denizen imports.

Sandwich: No accounts 1321/2; 1339-1354; 1365/6; 1468/9; 1382/3; 1395/6; 1398/9; 1400/1; 1411-1413; 1466-1467; 1481-1497; 1499-1517. 1303 is 10 Feb-29 Sept; 1310/1 is 29 sept-9 Oct; 1324/5 is 12 May-3 Feb; 1325/6 is 3 Feb-23 Jan; 1326/7 is 23 Jan-20 Jan; 1327/8 is 20 Jan-29 Sept; 1329/0 is 3 Oct-30 Sept; 1378/9-1381/2 is 20 Jan-20 Jan; 1382/3 is 20 Jan-29 Sept; 1398/0 is 29 Sept-26 Oct; 1390/1 is 26 Oct-29 Sept; 1391/2 is 7 Oct-8 Dec; 1392/3 is 8 Dec-8 Dec; 1393/4 is 8 Dec-5 Nov; 1394/5 is 5 Nov-5 Nov; 1397/8 is 17 Feb-17 Feb; 1398/9 is 17 Jan-29 Sept; 1402/3 is 29 Sept-22 Oct; 1403/4 is 22 Oct-29 Sept; 1404/5 is 29 Sept-1 Oct; 1405/6 is 9 Nov-29 Sept; 1407/8 is 29 Sept-28 Jul; 1408/9 is 28 Jul-29 Sept; 1421/2 is 29 Sept-31 Aug; 1422/3 is 31 Aug-29 Sept; 1426/7 is 29 Sept-8 Oct; 1427/8 is 8 Oct-29 Sept; 1437/8 29 Sept-20 Nov; 1438/9 is 20 Nov-29 Sept; 1450/1 is 28 Aug-7 Apr; 1451/2 is 7 Apr-29 Sept; 1460/1 is 16 Jan-4 Mar; 1461/2 is 4 Mar-29 Sept; 1463/4 is 29 Sept-13 Nov; 1464/5 is 13 Nov-16 Nov; 1467/8 28 Aug-29 Sept; 1468/9 includes denizen imports; 1469/0 is 6 Sept-8 Nov; 1470/1 is 8 Nov-8 Jun; 1471/2 is 8 Jun-6 Aug;

1472/3 is 6 Aug-29 Sept; 1473/4 is 29 Sept-17 Nov; 1474/5 is 17 Nov-17 Nov and includes denizen imports; 1475/6 is 17 Nov-29 Sept; 1468/9 is 20 Sept-6 Sept.

Southampton: No accounts 1302/3, 1321/2; 1335-1371; 1373-1375; 1376/7; 1383/4; 1474/5; 1476/7; 1498-1501. 1304/5 is 25 June-29 Sept; 1307/8 is 14 Dec-29 Sept; 1308/9 is 27 Oct-29 Sept; 13010/1 is 29 Sept-9 Oct; 1322/3 is 20 Jul-5 Oct; 1323/4 is 5 Oct-29 Sept; 1325/6 is 29 Sept-18 Dec; 1372/3 is 29 Sept-24 Dec; 1375/6 is 25 Dec-13 Feb; 1376 is 12 Feb-21 Jun; 1377/8 is 29 Sept-1 Nov; 1378/9-1379/0 is 1 Nov-1 Nov; 1380/1 is 1 Nov-16 Feb; 1382/3 is 16 Feb-29 Sept; 1383/4 is 29 Sept-20 Jan; 1385/6 is 20 Jan-26 Feb; 1386/7 is 26 Feb-22 Feb; 1387/8 is 22 Feb-29 Sept; 1390/1 is 29 Sept-8 Aug; 1391/2 is 8 Dec-8 Nov; 1392/3 is 8 Nov-29 Sept; 1400/1-1401/2 is 29 Sept-1 Oct; 1402/3 is 1 Oct-29 Sept; 1422/3 is 1 Sept-29 Sept; 1449/0 is 29 Sept-6 Oct; 1450/1 is 6 Oct-29 Sept; 1454/5 is 29 Sept-23 Aug; 1455/6 is 23 Aug-25 Dec; 1456/7 is 25 Dec-29 Sept; 1459/0 is 29 Sept-28 Aug; 1460/1 is 28 Aug-24 Jul; 1461/2 is 24 Jul-29 Sept; 1462/3 is 29 Sept-16 Jul; 1463/4 is 16 Jul-29 Sept; 1465/6 is 29 Sept-1 May; 1466/7 is 1 May-29 Sept; 1469/0 is 28 Aug-26 Oct; 1470/1 includes denizen imports; 1473/4 is 22 May-29 Sept; 1474-6 combined 29 Sept-3 Nov; 1476-8 combined 3 Nov-20 Jun; 1478/9 is 20 Jun-29 Sept; 1480/1 is 29 Sept-28 Jul; 1481/2 is 28 Jul-29 Sept; 1482/3 is 29 Sept-14 Dec; 1483/4 is 14 Dec-19 Nov; 1484/5 is 19 Nov-22 Aug; 1485/6 is 22 Aug-29 Sept.

Yarmouth: No accounts 1363-1392; 1405-6; 1440-1448; 1458-1481; 1484-1493; 1496-1507; 1509-1517. 1303 is 10 Feb-29 Sept; 1310/1311 is 29 Sept-9 Oct; 1322/3 is 11 Aug-29 Sept; 1326/7 is 29 Sept-26 Feb; 1334/5 is 29 Sept-16 Apr; 1340/1 is 29 Sept-14 Dec; 1341/2 is 14 is Dec-29 Sept; 1342/3 is 29 Sept-12 Apr; 1392/3 is 20 Jun-1 Apr; 1393/4 is 1 Apr-1 Apr; 1394/5 is 1 Apr-23 Feb; 1395/6 is 23 Feb-1 Apr; 1397/8 is 30 Apr-1 May; 1399/0 is 29 Spet-26 Nov; 1400/1 is 3 Dec-7 Nov; 1401/2 is 7 Nov-13 Nov; 1402/3 is 24 Nov-24 Nov; 1403/4 is 24 Nov-15 Feb; 1407/8 is 29 Sept-7 Mar; 1408/9 is 7 Mar-7 Apr; 1408/9 is 7 Mar-13 Aug; 1409/0 is 12 Aug-29 Sept; 1410/1 is 20 Sept-16 Oct; 1421/2 is 29 Sept-31 Aug; 1422/3 is 1 Sept-29 Sept; 1434/5 is 29 Sept-31 Oct; 1435/6 is 31 Oct-29 Sept; 1437/8 is 29 Sept-23 Mar; 1447/8 is 1 Dec-8 Apr; 1449/0 is 8 Apr-29 Sept; 1450/1 is 29 Sept-16 Jul; 1451/2 is 16 Jul-29 May.

Source: S. Jenks, ed., The Enrolled Customs Accounts: TNA:PRO E 356, E 372, E 364, 12 vols. (Kew, Surrey, 2004-2013)